PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	Group Art Unit: 2629
William J. Schonlau	Examiner: Osorio, Ricardo
Serial No. 10/776,401	
Filed: February 10, 2004	Docket No. SCHONL-42855
For: **PERSONAL VIEWER**	

DECLARATION OF WILLIAM J. SCHONLAU UNDER 37 C.F.R. §1.131

Commissioner for Patents
VIA E-FILE
Alexandria, Virginia

Dear Sir:

WILLIAM J. SCHONLAU hereby declares as follows:

1. I am the sole inventor of the subject matter of the above-identified application, U.S. Application Serial No. 10/776,401, filed February 10, 2004, which claims priority to a provisional application, U.S. Application Serial No. 60/446,507, filed February 10, 2003.

2. I conceived the subject matter of the present application prior to December 2, 2002, the date the Solomon application, U.S. Publication No. 2004/0130783, was filed with the United States Patent and Trademark Office. I

diligently worked at reducing the subject matter of the present application to practice up to and beyond the filing date of the Solomon reference, December 2, 2002.

3. I conceived of the personal viewer of the present application at least as early as April 1, 2002. Exhibit A is a description of my invention dated April 1, 2002. Exhibit A provides full support for each and every claim limitation in pending claims 1-31.

4. The information disclosed in Exhibit A was compiled approximately eight months before the Solomon application was filed. Moreover, Exhibit A is dated nearly two and one-half years before the publication of the Solomon reference. Therefore, I could not have known any of the information in the Solomon application as it was not publicly available at the time of my written disclosure embodied in Exhibit A.

5. I thereafter worked to reduce to practice my invention for a personal viewer for the next five months. I disclosed my invention to the Law Offices of Kelly Lowry & Kelley, LLP ("KLK") in August 2002 for the preparation of a provisional patent application, U.S. Application Serial No. 60/446,507, filed February 10, 2003. From approximately August 2002 to February 10, 2003, I submitted additional written disclosure, diagrams and drawings for the preparation of the above-identified provisional application. I exchanged emails with the attorneys at KLK on multiple occasions regarding draft copies of the drawings and the written description of the provisional application.

6. Specifically, on August 28, 2002 I sent KLK a written disclosure of my invention and inquired about the estimated costs for filing the provisional application,

requested a brief review of the potential patentability of my invention, and inquired about the feasibility of disclosing the contents of my invention without a loss of rights therein.

7. On November 10, 2002 I sent KLK a draft drawing of the torsional scan mirror, illustrating the operation of the torsional oscillator scan mirror about a mirror oscillation axis based on a scan drive signal and a scan drive coil.

8. On November 30, 2002 I sent KLK Figure 2 to provide an enlarged view of the personal viewer system, specifically the eyeglass display. This enlarged view showed the input of the modulated optical beam, scanner drive signal and motion signals communicated with the motion sensors and a scan assembly for display against ellipsoidal reflectors.

9. On January 20, 2003 I sent KLK an email regarding improvements to Figures 3 and 4. The submission of the revised Figures 3 and 4 were primarily to enhance the quality of the figures due to conversion degradation problems between MathCad and other applications.

10. On January 21, 2003 I communicated with KLK in multiple emails regarding clarification of several figures and clarification of a portion of the written description. The communications discussed the optical properties of the personal viewer system, including information on the wave energy emanting from the upper focus (scanning mirrors) that is reflected directly into the lower focus (user pupil) and eccentricities of the ellipsoid.

11. On completion of the provisional patent application preparation process, my invention was filed with the United States Patent and Trademark Office on February 10, 2003.

12. The undersigned declares that all statements made herein are of my own knowledge are true and all statements made on information and belief are believed to be true; and the statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such false statements may jeopardize the validity of the application or any registration resulting thereon.

Date: March 14, 2008

William J. Schonlau

Title:	**PERSONAL IMAGE VIEWER**
Inventor:	**William J. Schonlau**
Appl. No.:	x
Date:	4/1/2002

References Cited

US PATENT DOCUMENTS

4,340,878	7/20/82	Spooner..............xxx
4,349,815	9/14/82	Spooner..............xxx
4,897,715	1/30/90	Beanom..............xxx
5,040,058	8/13/91	Beanom..............xxx
5,129,716	7/14/92	Holakovszky.........xxx
5,546,492	8/13/96	Ansley................xxx
5,612,709	3/18/97	Sudo....................xxx
5,659,327	8/19/97	Furness...............xxx
5,714,967	2/3/98	Okamura..............xxx
5,742,262	4/21/98	Okamura..............xxx
5,790,284	8/4/98	Taniguchi.............xxx

ABSTRACT

This display device, worn as a pair of eyeglasses linked to a computer, DVD player or other image generator by a thin cord, provides its user with a wide-field, high resolution, low cost, full color stereo, see-through image display well suited to a wide variety of uses. Applications include general purpose interactive computer display, video entertainment or instruction, immersive virtual reality gaming, pilot or vehicle operator heads-up display, teleoperated task workspace display, technical reference overlay, navigational environment enhancement and night vision. The device optionally provides user head position and orientation parameters in real time for point-of-view dependent image rendering systems.

The device has two major components: (1) an **image generator** and (2) an **eyeglass display** worn by the user, connected to the image generator by an optical fiber. The **image generator** resamples the digital or video display image to correct for geometric distortion and modulates a tricolor optical source which is transmitted through an optical fiber to the display, see the summary block diagram in figure 1. The **eyeglass display** uses one of various means (i.e. torsional scanner, spinning polygonal mirrors, oscillating micro-mirror device, etc.) to raster-scan the optical signal across an ellipsoidal semi-reflective mirror that projects a widefield image through the user's pupil, onto the user's retina, see figures 2a and 2b.

xxx Claims, 5 Drawings

PERSONAL IMAGE VIEWER

BACKGROUND OF THE INVENTION

The background of this technology is essentially that of the **head mounted display**. xxx

With respect to the prior art, the current invention is contrasted with the various references cited in the preliminary patentability search reported September 4, 1998, the references are addressed in chronological order.

4,340,878 7/20/82 Spooner

The Spooner design differs from the current invention by scanning the raster image first, into two fiber optic ribbons (52) and second, onto a large *diffuse* reflective screen (14) for observation by the user from a comfortable distance. The size and distance of the screen do not permit movement with the user in any practical sense and since the same image is perceived by both of the user's eyes, no stereo viewing is possible. It is not clear why the system provides two *zones* (modulators, scanners, fiber optic ribbons, etc.) as both zones are viewed by both eyes. The horizontal scan into the fiber optic ribbon presents only one scan line and is time-division multiplexed, requiring very high mirror rotation speeds for high resolution images where the current invention optionally (it may be omitted) employs a fiber optic ribbon to scan several lines concurrently, thereby presenting a higher resolution image at much lower scan mirror rotation speeds. The current invention employs no diffuse reflecting screen, the ellipsoidal mirror is an integral part of the system optics and achieves a very high efficiency with respect to delivery of all optical energy directly to the user's retina.

4,349,815 9/14/82 Spooner

This refinement of the prior Spooner reference is very similar to the first with the exception that the two zone feature has been dropped.

4,897,715 1/30/90 Beamon

The first Beamon reference presents a design that employs none of the optical principles of the current invention. It should be noted that the complex assembly of optical elements (12) – (34) serve only to generate a planar image on the back projection screens (32) and (34), which could be generated by any of several other means, such as an LCD. The viewing optics (62) – (68) are independent of the generation process but offer various advantages. Unfortunately, the beam splitter (68) will reduce the image brightness to ¼ (at most) of that on the projection screens and the field width will be constrained by the characteristics of the projection lens (64). More problematically, the curvature and focal point positioning of the reflecting surface of the visor (60) is not developed and if constructed as shown would not perform well. For the projection lens (64) position shown, the spherical reflector will present a serious exit pupil problem and a very narrow field of view will be attained.

5,040,058 8/13/91 Beamon

The second Beamon reference replaces the image generation portion of the prior reference with a combination CRT and scan mirror, no discussion of the presentation optics for viewing is offered. As this design does not integrate image generation and viewing optics, it is not relevant to the current invention.

5,129,716 7/14/92 Holakovszky

The design in the Holakovszky reference also separates the image generation and display processes and is therefore not comparable to the current invention. The generation process utilizes an unspecified CRT or LCD based method to present an image on the screen (3). The projection of this image into the user's field of view from the side through half silvered mirrors is effective but limits the breadth of field perceived by the user to that of the projection lens (8). This field breadth will be less than half that attained by the current invention and the LCD/CRT and screen assembly will be much larger and heavier.

5,546,492 8/13/96 Ansley

The Ansley design employs an optical fiber ribbon (64), whose input may be a point source (52) scanned at high-speed 56 or multiple sources operating in parallel, to provide one dimension of the displayed image. The second dimension is produced by scanning (or oscillating) the ribbon orthogonal to the first dimension (74) while varying the fiber inputs in accordance with the image content and scan phase (76, 90). While this provides a satisfactory two-dimensional image for display, it must then pass through the projection optics (80) onto the viewing screen (82) for observation. Again, the scanning and projection systems are separate, not integrated as in the proposed method, and the same screen is seen by both eyes, excluding the presentation of stereo images.

5,612,709 3/18/97 Sudo

The Sudo method avoids awkward placement of display and projection apparatus in front of or above the user by means of an optical element (4) that allows placement to the side of the user's head and provides adjustments to accommodate varying user morphology. This method also separates image production (8), in this case a conventional LCD, and projection for viewing, and is therefore not similar to the current invention. While it would appear to provide a relatively wide field and support for stereo, this is not mentioned.

5,659,327 8/19/97 Furness

The Furness disclosure provides an unusually detailed discussion of the beam generation, modulation and combination processes but little clarification of how the viewing optics are structured or why they might be expected to perform adequately. While the modulation and combination processes are important components of the current invention, it is difficult to imagine that they are not subsumed by much earlier work and they are not considered an original or claimable component of the current invention. Furness claims (10) and (11) define a view-direction accommodation for the projection process that would benefit the current invention but had been thought excessively complex and expensive and therefore inappropriate.

5,714,967 2/3/98 Okamura

This disclosure also presents an electro-mechanical system for viewing direction accommodation in the spirit of Ferness claims 10 and 11 but employs a motor drive mechanism likely to be larger, heavier, slower, noisier and more expensive than the Ferness galvanometer design. The projection optics imply weight, bulk and inadequate breadth of field. Otherwise, the methodology presented as little common ground with the current invention.

5,742,262 4/21/98 Tabata

The Tabata design presents a clever defraction grating system for broadening the exit pupils of a display system utilizing traditional 2D image source and optics. The convex mirror (17) in figure 27 plays the role of a traditional optical element focusing the 2D image of the LCD, which is not comparable to the ellipsoidal mirror of the current invention which serves specifically to bring the point source beam directly to the user's pupils regardless of the direction in which the beam has been deflected.

5,790,284 8/4/98 Taniguchi

The Taniguchi designed, while difficult to read in various ways, appears to present a viewing system capable of varying the apparent depth of various image sources using "holographic lenses". The lenses are also used to control the flow of light to the left and right eyes, providing depth perception while accommodating visual field overlap. These methods do not relate to the techniques of the current invention.

SUMMARY OF THE INVENTION

This device, worn as a pair of eyeglasses linked to a computer, DVD player or other image generator by a thin cord, provides its user with a wide-field, high resolution, low cost, full color stereo, see-through image display well suited to a wide variety of uses. The device optionally provides user head position and orientation parameters in real time for point-of-view dependent image rendering systems.

The device has two major components: (1) an **image generator** and (2) an **eyeglass display** worn by the user, connected to the image generator by an optical fiber. The **image generator** resamples the digital or video display image to correct for geometric distortion and modulates a tricolor optical source which is transmitted through an optical fiber to the display, see the system overview in figure 1. The **eyeglass display** uses one of various means (i.e. oscillating micro-mirror device, spinning polygonal mirrors, etc.) to raster-scan the optical signal across an ellipsoidal semi-reflective mirror that projects a widefield image through the user's pupil, onto the user's retina, see the optical design in figures 2a and 2b.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows an overview of the Personal Viewer system consisting of two components: (1) the image generator and (2) the eyeglass display.

Figure 2a shows a side view of the optical configuration of the eyeglass display.

Figure 2b shows an overhead view of the optical configuration of the eyeglass display.

Figure 3a shows a torsional oscillator scanner which is the preferred method of scanning the optical beam within the viewer eyeglass assembly.

Figure 3b shows a MEM 2-axis scanning mirror device which is an alternative method of scanning the optical beam within the viewer eyeglass assembly.

Figure 3c shows the spinning hexagonal mirror mechanism which is an alternative method of scanning the optical beam within the viewer.

Figure 4 shows the optical principles and the path of the optical beam as it passes through the deflection system, off the reflecting ellipsoid and into the user's eye within the viewer eyeglass assembly.

Figure 5a shows the mathematical model of the projection system optics used to determine the beam path on the reflective ellipsoid, generating the raster image distortion that is corrected by the resampling algorithm and processor.

Figure 5b shows the path of the scanned optical beam on the reflective ellipsoid, developed from the mathematical model above, demonstrating the raster image distortion that is corrected by the resampling algorithm and processor.

Figure 6a shows the preferred method of mixing the three primary color optical light sources with a simple diffuse cavity to produce a single beam.

Figure 6b shows an alternative method of mixing the three primary color optical light sources with dichroic mirrors or coated prism to produce a single beam.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Scan Mechanism

In the preferred embodiment, the horizontal raster scan is performed by an electrically driven torsional oscillator, as shown in figure 3a.

Alternatively, the raster scan may be performed with a solid state micro-electronic mirror (MEM) device, as shown in figure 3b. This method provides minimum size, weight, noise and cost, while maximizing device reliability, life expectancy and image stability. Currently available MEM scanners lack sufficient scan frequency and angular scan breadth.

Alternatively, the raster scan may be performed with a rotating polygonal mirror, as shown in figure 3c.

It is also feasible to mix these scan modes, using a single axis solid state micro-mirror for the horizontal scan and a rotating polygonal mirror for the vertical scan.

Light Source Mixer

The preferred embodiment for the three primary color optical sources is the simple cavity mixer shown in figure 6a.

Alternatively, the sources may be mixed with dichroic mirrors or prisms, as shown in figure 6b. This method is slightly more efiicient but may be substantially more expensive.

CLAIMS

(1) An optical configuration that presents the user with a 120 degree horizontal field of view in each eye, with a 60 degree overlap at center, providing a total 180 degree field of view, approximating the total natural horizontal field of view of unencumbered human vision, with complete stereoscopic separation, using a raster scanned optical beam that is reflected from the inside surface of an ellipsoidal mirror, directly into the pupil of the user's eye.

(2) An optical configuration that presents the user with a 90 degree vertical field of view in each eye, approximating the natural vertical field of view of unencumbered human vision, with complete stereoscopic separation, using a raster scanned optical beam that is reflected from the inside surface of an ellipsoidal mirror, directly into the pupil of the user's eye.

(3) An optical configuration that directs all of the modulated light signal to the user's pupil.

(4) A resampling transformation that corrects the geometric distortion that naturally occurs with this projection method.

(5) Scanning mirror surfaces with graduated curvature to correct for the convergence resulting from reflection off the inside of the ellipsoidal reflector, providing a uniformly focused image.

(6) An optical configuration that presents a minimal extension of components beyond the surface of the user's face of approximately 2 cm, little more than ordinary eyeglasses.

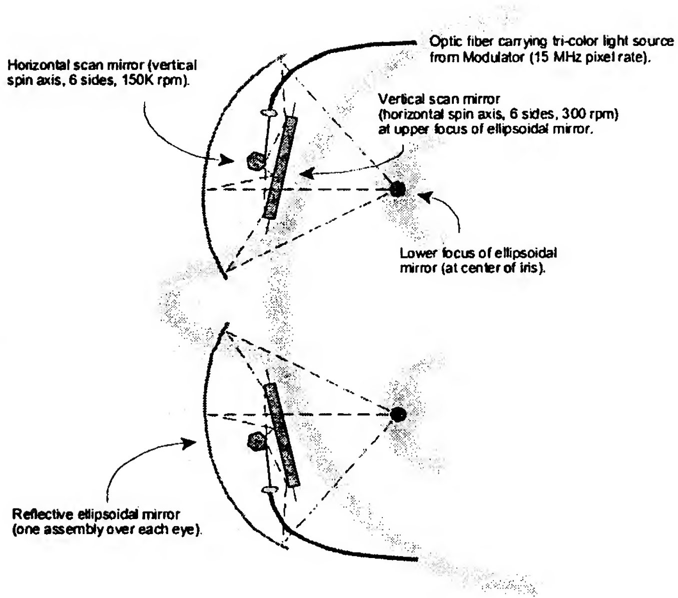

Figure 2b. Overhead view of eyeglass display optics.

Figure 3a. Torsional oscillator beam scanner.

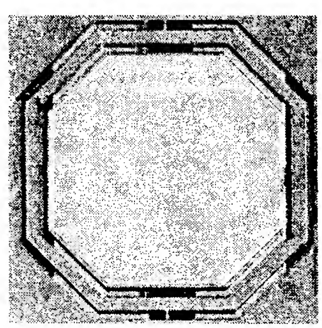

Figure 3b. Solid state MEM beam scanner.

EXHIBIT A

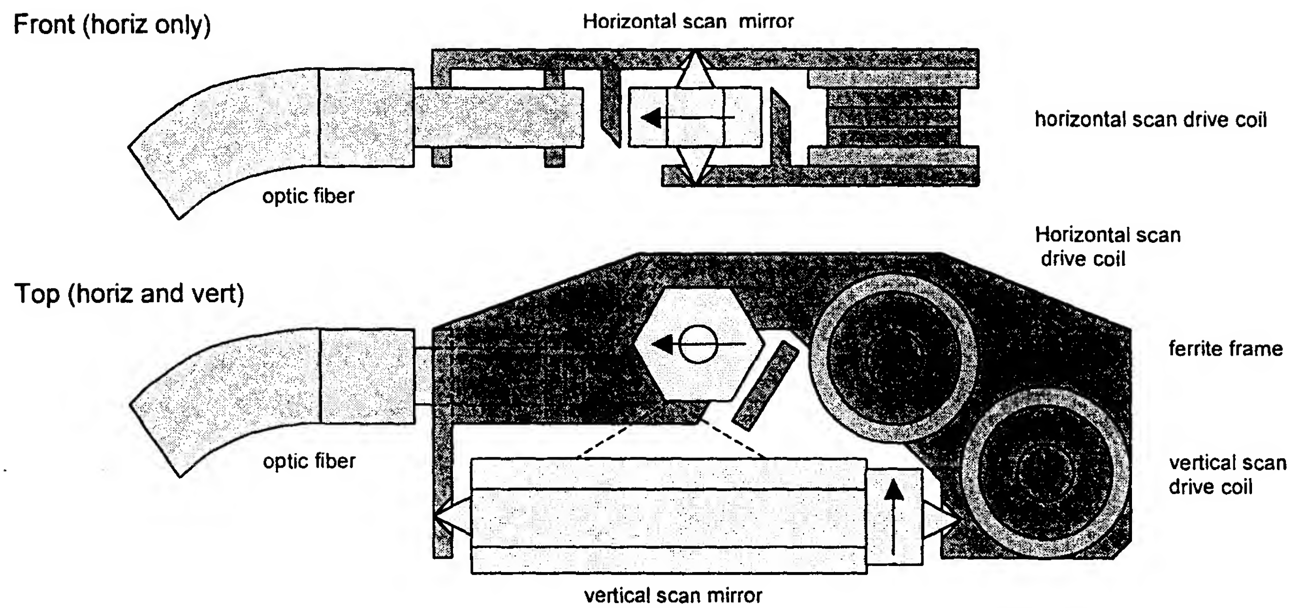

Figure 3c. Rotating hexagonal mirror beam scanner.

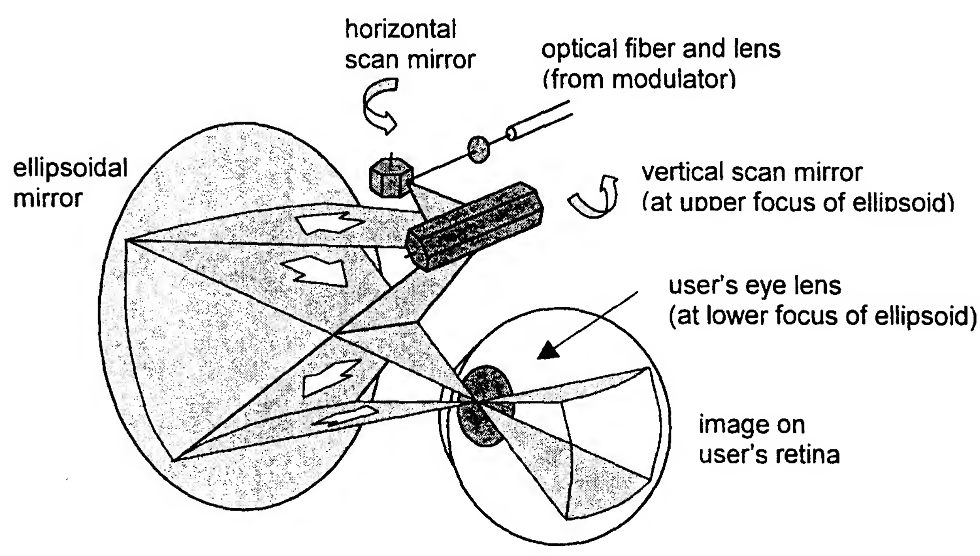

Figure 4. Alternative beam scanner using rotating polygonal mirrors.

EXHIBIT A

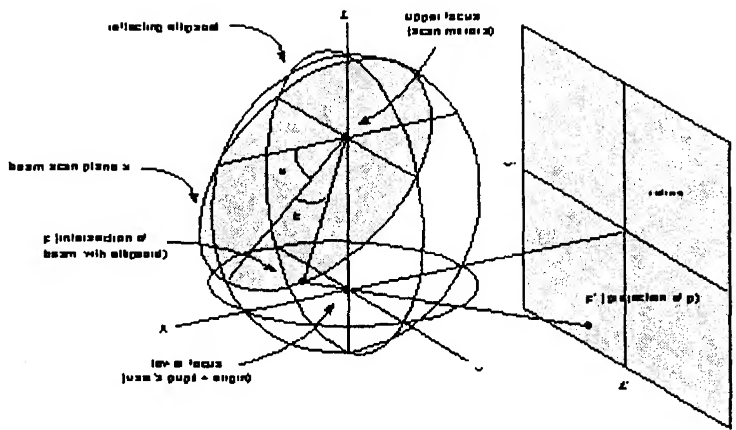

Figure 5a. Scan line trajectory geometric model.

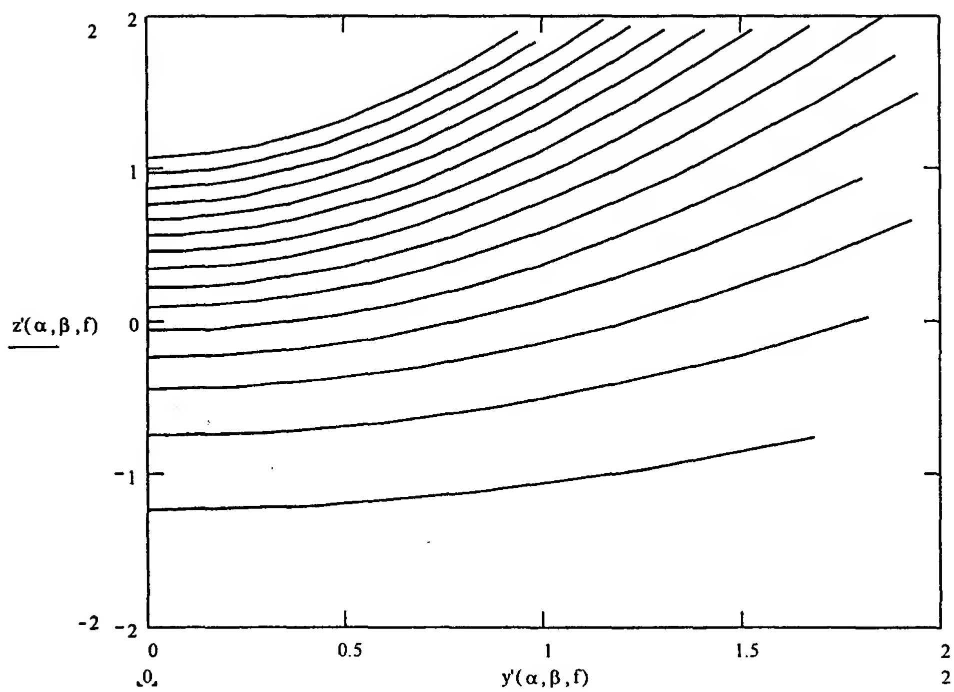

Figure 5b. Scan line trajectories seen by user (half field).

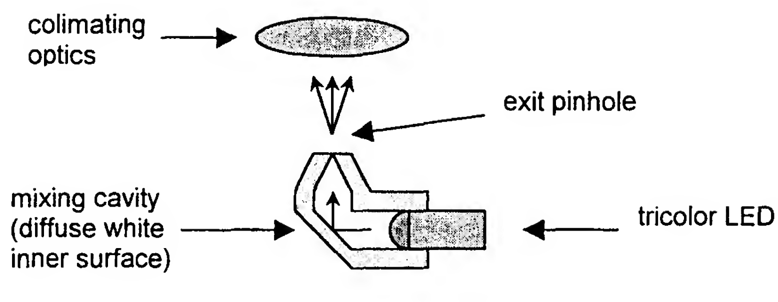

Figure 6a. Simple cavity tricolor light source mixer

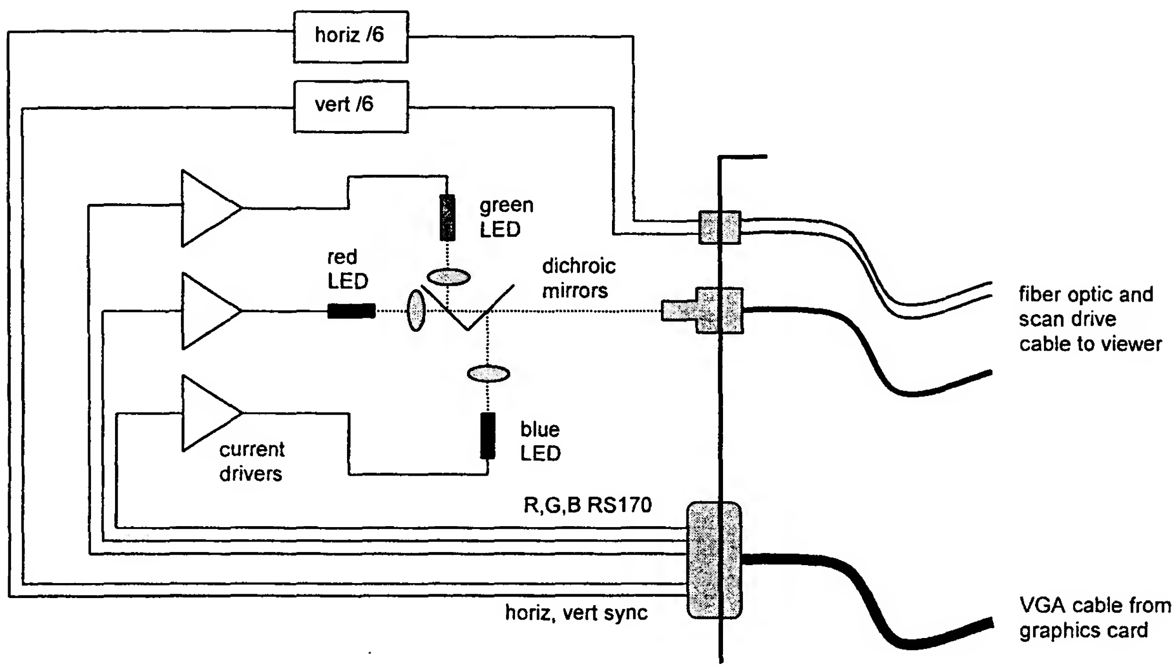

Figure 6b. Alternative method for mixing tricolor light source with dichroic mirrors.

EXHIBIT A